VOWEL CONTEXT AFFECTS DANISH L2 CHINESE LEARNERS' IDENTIFICATION OF POSTALVEOLAR SIBILANTS

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ABSTRACT

This study examines the identification of Standard Chinese initial consonants by native Danish students of Chinese as a foreign language (CFL). Segmental perception is known to be affected by neighboring segments, and in the case of Chinese, certain consonantal contrasts may be enhanced by the quality of the following vowel. We examined how well intermediate learners of Chinese could apply (implicit) knowledge of L2 phonology in their identification of Chinese coronal obstruents that are known to pose challenges. This paper focuses on two sets of postalveolar sibilants ([tɕ, tɕʰ, ɕ] and [tʂ, tʂʰ, ʂ]) that are often perceived and produced similarly by CFL learners.

Results show a hierarchy of correct identification depending on the following vowel: /i/ > /u/ > /a/. We suggest that learners rely on implicit knowledge of phonotactics when perceiving non-native contrasts.

Keywords: Nonnative speech perception, Mandarin postalveolars, vowel context effects.

1. INTRODUCTION

The coronal inventory of Standard Mandarin Chinese (also just Mandarin) consonants is much larger than that of Danish, so L1 Danish learners of Chinese as a foreign language (CFL) must focus their attention on a number of consonantal contrasts that they do not otherwise attend to. Specifically, the three-way contrast of the Mandarin sibilants ([ts, tsʰ, s], [tɕ, tɕʰ, ɕ] and [tʂ, tʂʰ, ʂ]) is quite rare amongst the world's languages [8], and recent studies have investigated how CFL learners acquire this novel contrast [9, 14]. In addition to these three sets of fricatives, and aspirated and unaspirated affricates, the coronal inventory also includes two alveolar stops [t] and [tʰ]. The rich inventory of 11 Mandarin coronals differs greatly from the Danish inventory with just six coronals [t, tˢʰ, s, ɕ, tɕ, tɕʰ].

As well as learning novel contrasts of L2 phones, language learners must also acquire knowledge of L2 phonotactics. The Mandarin syllabary consists of approx. 400 syllables excluding tones, a significantly smaller number than that of other major world languages such as English [5]. In Mandarin, the palatal sibilants may be followed by an [i], while dental and retroflex sibilants are followed by a homorganic syllabic consonant [ɹ] or [ɻ] [10], and it has been suggested that this alternation in vowel quality enhances the otherwise perceptually similar contrast. [11] found that palatals and dental sibilants were less easily discriminated by native and non-native listeners when both were followed by [i], whereas sibilant discrimination improved significantly for all listeners when the consonants preceded [i] and [ɹ] respectively, in accordance with the phonotactics of Mandarin Chinese. The otherwise very similar acoustic characteristics of Mandarin sibilants seem to be more distinct in the /i/ context because of the alternation in quality of the syllable nucleus. As for the high, rounded vowels, the alternation only pertains to the palatals, which are followed by [y], while dental and retroflex sibilants are all followed by [u]. All series of sibilants may be followed by a low vowel. We should note that the phonemic status of [tɕ, tɕʰ ɕ] is disputed given the predictable alternation of the following high vowels, which means that the palatals never contrast minimally with some of the other obstruent series. Syllables initiated by palatals with a non-high nuclear vowel are often analyzed as containing a medial high front segment (e.g. [4]), but this segmentation of the Chinese syllable is sometimes contested as it has been suggested that there is not a full segment in the transition between palatal C and non-high V [6, 7]

The aim of this study was to investigate the role of phonotactic knowledge on learners' perception. Specifically, we wanted to examine how well (if at all) intermediate learners of CFL can make use of predictable patterns in the Mandarin consonant-vowel phonotactic restrictions when they perceive coronal obstruents. The identification experiment included stimuli of 11 initial Mandarin consonants [t, tʰ, ts, tsʰ, s, tɕ, tɕʰ, ɕ, tʂ, tʂʰ, ʂ] in different vowel contexts, but we limit the scope of this paper to the results and implications derived for the six

postalveolar sibilants. The two series of postalveolars are known to be perceived and produced similarly by listeners whose L1 has only a single set of postalveolars (e.g. L1 English [3, 12]) and specifically for L1 English CFL learners [12] suggests that the confusion derives from the fact that the place of articulation of English /dʒ, tʃ, ʃ/ lies between the two Mandarin series. Previous research suggests similar perceptual problems for L1 Danish listeners [13]. For naïve L1 Danish listeners, palatals and retroflexes map onto the same L1 category, constituting in the terminology of the Perceptual Assimilation Model [1] either a Single-Category assimilation type or Category-Goodness assimilation type, and the ability to successfully discriminate such contrasts can be difficult for learners to acquire. In this study we examine L1 Danish learners' ability to correctly identify the two sets of postalveolars in three different vowel conditions to evaluate if learners can make use of implicit knowledge about L2 syllables in their perceptual judgments. We expect that distinct quality of the high vowels will help learners identify the initial postalveolar consonants more correctly, whereas we expect greater confusion between the two places of articulation in the [au] vowel condition as there are no further cues to the contrasts in the syllable.

2. METHODS

2.1. Participants

Fifteen third semester students from the China studies program at Aarhus University participated in the identification experiment as volunteers. Their ages ranged from 20-25. All participants had studied Mandarin at university level for one year, but they differed in relevant language and immersion experiences. Participants reported no hearing problems.

2.2. Stimuli

Five female native speakers of Mandarin Chinese were recorded producing three repetitions each of 35 CV syllables in the carrier phrase "我说的是＿" ("What I said was ＿"). Target syllables were presented to the speakers in standard pinyin orthography with the tonal diacritic for high level (first) tone, to allow for potentially uncommon or non-existent syllables. The speakers, aged 23-29, were familiar with pinyin, and their reading of the stimuli was unproblematic. The first author selected the best token from each speaker, which then was verified with 97% accuracy by a native Mandarin listener in a separate identification task. This resulted in stimuli selection of 5 x 35 = 175 unique tokens that

were used in the identification experiment. The 175 stimuli were randomly presented twice, resulting in 350 trials in all. The results reported in this paper are based on identification responses for 18 of the 35 syllables, i.e. the palatal and retroflex sibilants in three different vowel contexts. Table 1 presents the CV combinations of the selected stimuli.

Table 1: CV combinations selected as stimuli.

V \ C	tʂ	tʂʰ	ʂ	tɕ	tɕʰ	ɕ
/au/	[au]	[au]	[au]	[au]	[au]	[au]
/u/	[u]	[u]	[u]	[y]	[y]	[y]
/i/	[ɻ]	[ɻ]	[ɻ]	[i]	[i]	[i]

2.3. Procedure

Participants first received a short written passage of Chinese text given in characters, which they transcribed in standard pinyin orthography. This was to ensure familiarity with the pinyin letters as response categories. The experiment was conducted in a sound attenuated booth in the speech laboratory at Aarhus University. Some of the participants were tested in pairs where two students sat in opposite facing directions and ran the experiment from separate computers over high quality headphones at the same time. The identification experiment was run in Praat [2], and response options were given on the screen in corresponding pinyin letters. The entire experiment included 11 initial coronal obstruents in Mandarin, so pinyin letters <d, t, z, c, s, zh, ch, sh, j, q, x> were all included as response categories. The following presentation and discussion of data will be limited to results from the stimuli with initial [tʂ, tʂʰ, ʂ, tɕ, tɕʰ, ɕ] (i.e. <zh, ch, sh, j, q, x>). The five alveolar consonants [t, tʰ, ts, tsʰ, s] will also be discussed when the corresponding orthographic responses <d, t, z, c, s> were selected as response categories for the postalveolar tokens. There was no time limit on the participants' responses, but they were encouraged to respond as fast and as accurately as possible. Stimuli were presented with an ITI of 0.5 seconds after the response was registered.

3. RESULTS

Tables 2, 3, and 4 show the response matrices for the six Mandarin postalveolar sibilants as identified by Danish intermediate learners. Results are presented according to the vowel context of the stimuli and discussed separately. Only the low vowel context /au/ has the same vowel quality across the two sibilant series, which differ in place of articulation. The quality of high vowels alternates predictably. In the

tables below, cells of correct responses are highlighted, and responses of less than 5% are not included. Alveolar response categories are added in rows below the six postalveolars in all three tables so all incorrect responses >5% can be reported.

Table 2: Identification responses of stimuli in the /au/ condition (see text). Accurate identification responses are highlighted.

Responses \ Stimuli	tʂ	tʂʰ	ʂ	tɕ	tɕʰ	ɕ
tʂ	57%			13%		
tʂʰ		83%			9%	
ʂ			64%			8%
tɕ	41%			80%		
tɕʰ					28%	
ɕ			31%			89%
tʰ		7%			52%	
tsʰ		5%			9%	

Table 2 shows that correct identification of the six postalveolars varies considerably in the /au/ condition. The aspirated palatal affricate /tɕʰ/ is misheard as /tʰ/ in 52% of the trials, and only in 9% of the responses misidentified as its retroflex counterpart /tʂʰ/. Palatal place confusion in the direction of retroflexes is limited (8% - 13%), whereas two retroflex tokens are misheard as palatals more frequently (31% - 41%).

Table 3: Identification responses of stimuli in /u/ condition.

Responses \ Stimuli	tʂ	tʂʰ	ʂ	tɕ	tɕʰ	ɕ
tʂ	85%			19%		
tʂʰ	5%	84%	21%			
ʂ			69%			11%
tɕ	7%			69%	6%	
tɕʰ		7%		7%	83%	23%
ɕ						53%
s						6%

Accurate identification scores of postalveolars also vary considerably (53% - 85%) when they precede high rounded vowels as shown in Table 3. The greatest source of confusion is found for the perception of the fricatives, which are misidentified as the homorganic aspirated affricate in 21% and 23% of instances. Confusion between the two postalveolar series is most notable in the direction of retroflexes, with 11-19% of palatal tokens misidentified as their retroflex counterpart.

Table 4: Identification responses of stimuli in /i/ condition.

Responses \ Stimuli	tʂ	tʂʰ	ʂ	tɕ	tɕʰ	ɕ
tʂ	89%	7%		6%		
tʂʰ		84%	5%		6%	
ʂ			90%			
tɕ				81%		
tɕʰ		6%		5%	73%	5%
ɕ						77%
tʰ					8%	
ts						7%
tsʰ					6%	

Table 4 above shows the identification matrix for the high, unrounded vowel condition. When followed by [i] or the syllabic consonant [ɻ], the two series of Chinese postalveolar sibilants are generally identified with higher accuracy (73% - 90%) than in the two other vowel conditions. Place confusion between the two sets of postalveolars is limited to 6% for some of the affricate pairs. The fricatives /ɕ/ and /ʂ/ are not confused with each other, but sometimes mistakenly heard as their respective homorganic aspirated affricate.

Taken together, the data from the three separate vowel conditions indicate that Danish learners' identification of Mandarin postalveolar sibilants is strongly affected by the following vowel.

4. DISCUSSION

This study revealed a number of expected and unexpected findings regarding the effect of the following vowel on L1 Danish learners' identification of Mandarin postalveolar sibilants. We had expected a larger percentage of misidentification errors between the two sets of postalveolar sibilants in the /au/ condition because of the shared vowel quality across the place contrast. This hypothesis was partially supported with a range of these specific place errors from 8% - 41% in the /au/ condition, 7% - 19% in the /u/ condition, and 0 – 6% in the /i/ condition.

Since the vowel quality differs greatly between retroflex and palatal initiated syllables in the /u/ condition ([u] and [y], respectively), we had not expected misidentification of consonants in this condition to be as frequent as was the case. Danish has a phonemic distinction between /u/ and /y/, so L1 Danish learners of Mandarin are sensitive to the front rounded vowel that occurs in some syllables. Beginning learners of Mandarin may initially be confused by the representation of this vowel in pinyin orthography, which is <u> after palatals <j, q, x> and <ü> after <n, l>. All participants in this experiment

had demonstrated perfect pinyin transcription of segments, but we did not examine their pronunciation prior to testing. It is possible that some of the participants could have pronounced <qu> ([tɕʰy]) as [tɕʰu], but we find this explanation unlikely considering how frequently this syllable occurs in the Mandarin lexicon, e.g. in 去, "to go". It is more likely that students were not aware of all the cues that may assist them in distinguishing between palatals and retroflexes, as the present experiment was deliberately conducted before the participants had received any explicit teaching on Mandarin phonetics and phonology. It would be interesting to examine the effect of explicit instruction, and it would be equally interesting to compare the present results with those from a group of learners whose L1 does not contrast /u/ and /y/. One could expect that L1 English learners, whose L1 does not have an /y/ vowel, would have even greater problems identifying retroflex and palatal consonants correctly in the /u/ condition.

In the /i/ condition, confusion between the two postalveolar series was minimal, which supports the claim advanced by e.g. [11] that the contrast is enhanced by the notably different syllable nuclei [i] and [ɻ̩]. The overall identification accuracy rates are much higher in the /i/ condition, and the highest incidence of confusions is limited to 8% of instances in which [tɕʰ] is classified as /tʰ/. This error does not seem surprising considering that both [tɕʰi] and [tʰi] are licit Mandarin syllables. In the /au/ condition the misidentification rate of [tɕʰ] for /tʰ/ is even higher (52%), and the existence of the two syllables [tɕʰau] (<qiao>) and [tʰʲau] (<tiao>) explains why this particular rhyme is likely to cause confusion between the alveolar stop and the affricate.

We did not include responses for alveolar obstruents in this paper, but it is noteworthy that the aspirated palatal affricate is not only likely to be confused with its retroflex counterpart: This study presents support for it being misperceived as the aspirated alveolar stop in one condition. According to the literature on Mandarin phonetics (e.g. [15]), the palatals are acoustically most similar to the dental sibilants [ts, tsʰ, s], so there is reason to expect confusion of the palatals with several other Mandarin consonants. The Mandarin coronal inventory consists of consonants that L2 learners may find difficult to perceive correctly (e.g. [9, 14]), and some of these difficulties are clearly related to the L2 learner's native consonant inventory. This study further suggests that learners' correct identification of Mandarin coronal obstruents, specifically the postalveolar sibilants, indeed depends in large part on the vowel context and on the CV combinations that are phonotactically licit in the syllabary.

5. REFERENCES

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